

**TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION**

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**CALSPAN ON-SITE SIDE IMPACT AIR BAG DEPLOYMENT INVESTIGATION
CALSPAN CASE NO. CA97-037
VEHICLE: 1998 BMW 740iL
LOCATION: MISSOURI
CRASH DATE: OCTOBER, 1997**

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points are coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

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16. <i>Abstract</i> This on-site investigation focused on the performance of the side impact air bag system in a 1998 BMW 740iL. The BMW was equipped with an Advanced Side Airbag Protection (ASAP) system that consisted of four door mounted side impact air bags, and two Inflatable Tubular Structures (ITS) head bags. The left side impact air bags and head bag deployed as a result of an intersection-type crash with a 1993 Pontiac Grand Am. The BMW was occupied by the 45 year old female driver and her two teenage sons who were positioned in the right front and left rear seated positions. The driver of the BMW sustained a soft tissue knee contusion (AIS-1) from contact with the knee bolster. The left rear seated occupant sustained a left lateral chest contusion and a left arm contusion (AIS-1) from his involvement with the deploying left rear side air bag. The right front occupant of the BMW was not injured. The driver of the Pontiac was unrestrained and she reportedly sustained a pelvic fracture			
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CALSPAN ON-SITE SIDE AIR BAG DEPLOYMENT INVESTIGATION

CALSPAN CASE NO. CA97-037

VEHICLE: 1998 BMW 740iL

LOCATION: MISSOURI

CRASH DATE: OCTOBER, 1997

BACKGROUND

This on-site side impact air bag deployment crash investigation focused on a front-to-side impact configuration that involved a 1998 BMW 740iL and a 1993 Pontiac Grand Am. The BMW was equipped with an Advanced Side Airbag Protection (ASAP) system that consisted of four door mounted side impact air bags and two Inflatable Tubular Structures (ITS) head bags. The left side impact (**Figure 1**) deployed



Figure 1. Left side damage to the BMW 740iL.



Figure 2. Test image of the deployed side impact air bags.

the left side impact air bags and head bag (**Figure 2**) as a result of the impact with the Pontiac. The BMW was occupied by the 45 year old

female driver and her two teenage sons who were positioned in the right front and left rear seated positions. The driver of the BMW sustained a soft tissue knee contusion (AIS-1) from contact with the knee bolster. The left rear seated occupant sustained a left lateral chest contusion and a left arm contusion (AIS-1) from his involvement with the deploying left rear side air bag. The right front occupant of the BMW was not injured. The driver of the Pontiac was unrestrained and she reportedly sustained a pelvic fracture.

Notification of this crash was initially provided to NHTSA by BMW of North America. The investigation was assigned to Calspan's Special Crash Investigation Team on Thursday, October 16, 1997. Due to the deployment of the BMW's side air bag system, inclusive of the ITS, an on-site effort was assigned and the investigation was initiated on Monday, October 20.

SUMMARY

Crash Site

The crash occurred at a complex junction area of a rural three-leg T-intersection with adjacent ramps providing access to and egress from a rural expressway (**Figure 3**). The driver of the BMW was traveling on a two-lane local roadway which intersected a four lane arterial. Traffic flow for the BMW's path of travel was controlled by a stop



Figure 3. Overall view of the crash scene.

sign while east/westbound traffic flow was uncontrolled through the intersection. The arterial was straight with a positive grade of 1.5 percent for the Pontiac's southbound direction of travel. The asphalt road surface was dry during the daytime crash. Posted speed limits were 80 km/h (50 mph) for the arterial and 40 km/h (25 mph) for the local road.

Pre-Crash

The driver of the BMW was traveling in an easterly direction on the two-lane local road as she approached the T-intersection. She decelerated on her approach and stopped at the mouth of the intersection for the regulatory stop sign. The driver failed to detect the approaching southbound Pontiac and initiated a shallow angle left turn to cross the four lane roadway and enter the ramp for the rural expressway.

The Pontiac was traveling on the inboard lane of the arterial roadway at an estimated speed of 64-80 km/h (40-50 mph) in the 72 km/h (50 mph) speed zone. Although a witness to the crash stated that the driver of the Pontiac did not have sufficient time to initiate maneuvers, she probably braked immediately prior to impact in an attempt to avoid the impending crash. There was no physical evidence (i.e., skid marks) at the crash scene from the ABS (4-wheel anti-lock braking system) equipped Pontiac Grand Am.

Crash

The full frontal area of the Pontiac Grand Am impacted the left front side area of the BMW 740 iL in a L-configuration crash. Resultant directions of force were 10 o'clock for the BMW and within the 01 o'clock sector for the Pontiac. The damage algorithm of the WINSMASH reconstruction program computed total velocity changes of 18.5 km/h (11.5 mph) for the BMW and 30.6 km/h (19.0 mph) for the striking Pontiac. The lateral component for the BMW was computed at 16.1 km/h (10.0 mph) while the longitudinal component for the Pontiac was computed at -26.4 km/h (-16.4 mph). As a result of the left side impact, the BMW's left side impact air bag system deployed.

The impact deflected the BMW in a clockwise direction as it came to rest within the intersection facing in a southeasterly direction. The Pontiac was rotated in a counterclockwise direction by the lateral component of the 1 o'clock impact force. The final rest positions were not documented by the investigating officer and there was no physical evidence at the crash scene to support final rest.

Post-Crash

Immediately following the crash, the driver of the BMW turned the ignition to the off-position. The vehicle's power door lock system automatically unlocked following the crash. The driver attempted to open the jammed left front door, however, she could not open the deformed door. The right front occupant opened the right front door and exited the vehicle unassisted. The driver slid across the interior of the vehicle and exited through the right front door. The left rear seated occupant opened the right rear door and exited the vehicle unassisted. All occupants of the BMW refused medical treatment at the scene of the crash and did not seek treatment at a later time. The driver of the Pontiac Grand Am was removed from the vehicle by rescue and transported by ambulance to a local hospital where she was admitted for treatment of her injuries.

VEHICLE DATA/HISTORY

The 1998 BMW 740iL, 4 door sedan, was manufactured on 5/97 and was identified by vehicle identification number (VIN) WBAGJ8322WD (production number deleted). The vehicle was powered by a 4.4 liter, V-8 gasoline engine coupled to a 5-speed automatic transmission with Adaptive Transmission Control (ATC). A console mounted transmission shifter was centered between the front bucket seats. Braking was achieved by power-assisted four-wheel disc brakes with anti-lock (ABS). The driver stated that she and her husband had leased the 740iL approximately four months prior to the crash. She noted that they had previously leased three other BMWs and were familiar with the performance and driving characteristics of the vehicle. The driver stated that she was aware of the frontal driver and passenger air bags, however, she was not aware of the side air bags or the ITS head air bag. Therefore, the side air bag system was not a factor in their selection process of a vehicle. The driver was the primary operator of the vehicle and had personally amassed the majority of the mileage on the vehicle. At the time of the crash, the odometer had recorded 10,349 km (6,431 miles).

VEHICLE DAMAGE

BMW-Exterior

The BMW sustained moderately severe damage to the left front side area from its intersection-type crash with the Pontiac Grand Am. The direct contact damage began at the left front corner area of the bumper fascia and extended 205.1 cm (80.75") rearward across the left front fender onto the left front door panel (**Figure 4**). The contact damage consisted of red paint transfers, abrasions, and the deformation pattern that ended to the rear third area of the left front door, terminating 170.2 cm (67.0") forward of the left rear axle.



Figure 4. Left side damage to the BMW 740iL.

Structural members of the BMW that were contacted by the Pontiac included the left front axle position (steering and suspension components), the left A-pillar, and the left sill area of the vehicle. The impact produced damage profiles at two levels; the mid door level and at the sill of the BMW. Separate crush profiles were documented at these levels.

Maximum crush was 23.1 cm (9.1") located on the left front door panel 214.6 cm (84.5") forward of the left rear axle position. The crush profile at the mid door level (**Figure 5**) was as follows: C1 = 0 cm, C2 = 14.2 cm (5.6"), C3 = 13.3 cm (5.25"), C4 = 18.4 cm (7.25"), C5 = 22.6 cm (8.9"), C6 = 0 cm. Maximum crush at the sill of the vehicle was 9.5 cm (3.75") located at the base of the A-pillar. The sill crush was documented at the locations of C1-C3 and was as follows: C1 = 0 cm, C2 = 4.1 cm (1.6"), C3 = 9.5 cm (3.75"). The Collision Deformation Classification (CDC) for this damage pattern was 10-LYEW-3.



Figure 5. Longitudinal view of the left side damage to the BMW.

Damaged Components

The left side impact damaged the left corner of the front bumper fascia, left turn signal assembly, left front fender, hood, left outside rear view mirror, and the left door. The impact involved the left front tire and wheel which transmitted damage into the suspension and shock tower. The left A-pillar was displaced laterally which resulted in stress-type cracks to the laminated windshield adjacent to the pillar. The left front door was deformed which shattered the tempered door glazing. Although damaged, the left front door remained closed during the crash. The door was subsequently forced open and due to the deformation, would not close. The left rear and right side doors remained closed during the crash and operational post-event. The BMW 740iL was repairable. A damage estimate was prepared by the dealership which totaled \$18,338.46.

BMW-Interior

The interior of the BMW sustained moderate damage that was associated with external deformation (intrusion) and the deployment of the left side impact air bag system. Additional minor damage to the interior resulted from occupant contact during the crash.



Maximum intrusion involved 8.6 cm (3.4") of lateral displacement of the left lower A-pillar/sill juncture point (**Figure 6**). The lower and forward aspect of the left front door panel intruded approximately 5.1 cm (2.0") into the driver's position. There was no intrusion into the left rear occupant space.

Figure 6. Intrusions of the left front occupant space.

The deployment of the left side impact air bag system produced damage to the left front and rear door trim panels. Both side impact bags deployed as designed which resulted in separation of the exterior cover flap that was incorporated into the trim panel. The left side head air bag deployed from the side rail and A-pillar areas of the vehicle. The headliner and A-pillar covering was designed to disengage from a series of retaining clips which allowed for the deployment and expansion of the bag. There was no residual damage associated with the deployment of this head air bag.

Occupant contact damage within the vehicle was limited to lateral deflection of the front center fold-down armrest. The unrestrained right front passenger initiated a lateral trajectory to the left and displaced the armrest approximately 2.5 cm (1.0") to the left. The driver's left knee probably contacted the knee bolster, however, there was no contact evidence to support the contact sequence.

Pontiac-Exterior

The 1993 Pontiac Grand Am sustained severe frontal damage (**Figure 7**) as a result of its impact sequence with the left side of the BMW. The front bumper fascia separated from the frontal structure of the vehicle, therefore the crush profile was documented at the honeycomb bumper reinforcement bar. The direct contact damage was 138.4 cm



Figure 7. Frontal damage to the Pontiac Grand Am.

(54.5") in length which spanned the full width of the fascia. The combined induced and direct contact damage length of the deformed frontal structure was 120.7 cm (47.5") which extended across the full width of the reinforcement bar. Maximum crush was 42.5 cm (16.75") located on the bumper reinforcement bar 36.2 cm (14.25") left of the centerline. The crush profile documented at the bumper reinforcement bar was as follows: C1 = 41.7 cm (16.4"), C2 = 42.5 cm (16.75"), C3 = 36.6 cm (14.4"), C4 = 31.8 cm (12.5"), C5 = 26.0 cm (10.25"), C6 = 5.7 cm (2.25"). The left wheelbase was reduced by 8.9 cm (3.5") while the right wheelbase was elongated by 3.6 cm (1.4") due to the lateral displacement to the left. The CDC was 01-FDEW-2.

AUTOMATIC RESTRAINT SYSTEMS

As previously noted, the BMW was equipped with eight air bags that were designed to offer automatic protection to the four outboard seated occupants in both frontal and side impact crashes (**Figure 8**). The frontal driver and passenger air bag system was a totally separate safety system from the side impact air bag system. In addition to the typically configured driver and top mounted right passenger frontal air bags, the front 3-point manual lap and shoulder belts systems were equipped with pyrotechnic pretensioners. The pretensioners were incorporated into the inboard aspect of the seat cushions. Upon deployment of the frontal system, the pretensioner, via a cable, would pull the front seat belt buckle assembly in a downward direction, thereby removing the slack from the lap and shoulder belt webbing. Due to the side impact configuration and the 10 o'clock impact force, the frontal air bag system (and pretensioners) did not deploy.



Figure 8. View of the BMW's frontal and side impact air bag systems.

The frontal automatic restraint system utilized dual threshold "smart" technology. The air bag diagnostic sensing and control unit monitored three functions: frontal impact severity; front seat belt usage; and whether the front passenger seat was occupied. This system limits frontal air bag deployment to higher severity crashes when the front belt systems are used. If the right front seat is not occupied, the frontal air bag and the pretensioner will not deploy.

In addition to the frontal air bag system which did not deploy in this crash, the BMW was equipped with an Advanced Side Airbag Protection (ASAP) system. This system consisted of door mounted side impact air bags for the four outboard seated positions and a Head Protection System (HPS) for the front outboard seated positions (**Figure 9**). The side impact air bags provided lateral protection for the torso in side crashes while the HPS offered protection to the head and helps to prevent over-flexing of the neck to the outboard side.



Figure 9. Deployed side impact and ITS bags for the driver's position.

The side impact air bags were incorporated into the mid rear aspect of the four door panels. The respective side impact air bags were designed to deploy only in the event of a direct side impact crash. The off-side bags do not deploy. The door mounted side air bags were concealed by the leather door panel trim that was identified by the word AIRBAG embossed in the upper rear aspect of the cover. A dense foam backer panel was affixed to the leather outer cover flap and attached to the module assembly by a synthetic mesh tether. The side air bag membrane subsequently deployed from a plastic, four panel module cover flap assembly that concealed the bag membrane within the module assembly. The inflator/air bag was an independent component from the exterior (leather) trim module compartment cover. The left front door mounted leather cover flap was trapezoidal in shape with a top length of 30.5 cm (12.0") and a bottom length of 19.1 cm (7.5"). The overall height of the cover was 14.9 cm (5.9") The foam backer was approximately 7.9 mm (5/16") in thickness and mirrored the exterior shape of the leather cover flap. The backer was tethered to the door mounted inflator assembly by a 10.2 cm (4.0") wide-band mesh tether than extended approximately 10.2 cm (4.0") outward from the vertical surface of the door panel (**Figure 10**). The secondary plastic cover flaps that concealed the air bag membrane within the inflator assembly were rectangular in overall shape and opened in an H-configuration with triangular side flaps, forming four separate cover flaps. The overall dimensions of these cover flaps were 10.2 cm (4.0") vertically and 17.3 cm (6.8") horizontally. The flaps opened at the designated tear points.



Figure 10. Tethered cover flap for the left front door mounted side impact air bag.

The left front side air bag was rectangular in shape and measured 30.5 cm (12.0") in height and 45.7 cm (18.0") horizontally. The bag was constructed of a typical woven nylon type fabric that was sewn with an external peripheral seam. The left front side air bag was tethered with an internal tether which restricted the mid point of the bag to a depth of approximately 11.4 cm (4.5"). A green stitch pattern in the shape of a J identified the location of the internal tether. There were no direct vent ports located on the exposed area of the air bag.

The left front (driver) position was provided head and neck protection by a Head Protection System (HPS) that involved the deployment of the Inflatable Tubular Structure (ITS) head air bag. The ITS bag was concealed within the side rail and retained in place by a series of plastic clips that extended from the A-pillar (**Figure 11**) to the C-pillar. The padded headliner was fitted into the side rail trim which concealed the ITS bag. At deployment, the ITS expanded within the side rail which separated the headliner from the trim panel. This separation acted as the module cover which allowed the ITS bag to deploy and offer protection to the driver.



Figure 11. Forward aspect of the ITS at the left A-pillar.

At the time of inspection, the ITS bag was fully deflated and deployed from the side rail area. The bag consisted of a heavy gauge translucent plastic bladder that was wrapped with a loose weave nylon-type (air bag-like) fabric. The bag was 102.9 cm (40.5") in length and 10.2 cm

(4.0") in width in its deflated state. Specifications for the ITS identified a maximum inflation diameter of 12.9 cm (5.1"). The bag was attached to the lower third of the left upper A-pillar by a 2.5 cm (1.0") wide nylon tether strap. The A-pillar tether extended approximately 17.8 cm (7.0") rearward of the A-pillar. At this point, the bag inflated to a cylindrical shape. The inflator was housed in the base of the upper A-pillar at the left corner of the upper instrument panel. The trailing aspect of the ITS bag was attached to the juncture of the left C-pillar and the roof side rail by a 2.5 cm (1.0") tether strap that was approximately 48.3 cm (19.0") in length. Both tethers were attached to the respective pillars by a D-ring type bracket which was allowed to pivot at the mounting points. A stitch pattern that was 4.8 cm (1.9") in length secured the ITS bag to the tether straps. At the time of our inspection, the ITS bag was loosely tethered between the pillars with a bow (sag) in the bag that was approximately 10.2 c (4.0") located at the forward third area of the bag. There was no damage or occupant contact evidence on the ITS bag. Several areas of a grease or oily type transfers were noted to the bag, however, these resulted from post-crash handling of the bag by employees of the dealership and body repair shop.



Figure 12. Deployed left rear door mounted side impact air bag.

The left rear door side impact air bag was concealed under a similar leather cover flap to the left front door system (**Figure 12**). The leather cover was backed by the foam panel which was tethered to the inflator assembly. The left rear tether was 10.2 cm (4.0") in width, however, the length was 3.8 cm (1.5") which hinged the external cover flap close to the door panel. The bag membrane was concealed within a secondary cover flap similar to the left front system. The rear secondary flaps were 16.2 cm (6.4") in width and 8.3 cm (3.25") vertically. The deployed left rear side impact air bag was larger than the left front side impact air bag with overall dimensions of 35.6 cm (14.0") vertically and 50.8 cm (20.0") horizontally. The rear bag was tethered

by a single internal tether that was sewn to the center area of the bag in a J-configuration. There were no direct vent ports for the rear side air bag. At the time of our inspection which occurred 17 days post-crash, a small amount of residual gas remained in the bag. There was no contact evidence on the door mounted air bags.

HUMAN DEMOGRAPHICS/OCCUPANT DATA

Air Bag Vehicle

Driver:	45 year old female
Height:	170.2 cm (67.0")
Weight:	63.5 kg (140 lb)
Eyewear:	Prescription eyeglasses, displaced from face
Manual Restraint	
Usage:	3-point lap and shoulder belt system
Usage Source:	Driver interview
Vehicle Familiarity:	4 months, primary driver of leased vehicle
Trip Plan:	Returning to residence
Medical Treatment:	None, refused treatment

Driver Kinematics

Injury	Injury Severity (AIS-90)	Injury Mechanism
Contusion over the anterior aspect of the left leg, distal to the knee	Minor (890402.1,2)	Knee bolster
Forehead pain	N/A, not a codeable injury	Head air bag (ITS), impact forces

Driver Kinematics

The driver of the 1998 BMW was a 45 year old female with a stated height of 170.2 cm (67.0") and weight of 63.5 kg (140.0 lbs). She stated that she was wearing the manual 3-point lap and shoulder belt system. There was no loading evidence on the belt webbing from her lateral trajectory toward the left front door. The pretensioner did not fire, therefore the belt webbing freely extended and retracted onto the belt sensitive, B-pillar mounted retractor. The latchplate of the belt system was faintly abraded which indicated usage over the four months of vehicle service. She was wearing a knit shirt, slacks, and prescription eyeglasses. The driver stated that there was no damage to the clothing, however, her eyeglasses separated from her face and came to rest on the floor of the vehicle. She was not wearing jewelry (i.e. watch/bracelet) on her left wrist. She was seated in a normal driving posture with the power seat adjusted to a forward track position, approximately 6.4 cm (2.5") aft of the full forward position. The seat back was found in a normal reclined driving position. The lateral lumbar support for the left front seat protruded 6.4 cm (2.5") forward of the left B-pillar, and slightly forward of the left front door mounted side air bag cover flap. Although there was no power to the vehicle at the time of our inspection, the electrically operated tilt and telescopic wheel appeared to have been adjusted to the mid positions.

At impact, the ASAP left side impact air bag system deployed. The driver subsequently responded to the 10 o'clock impact force by initiating a lateral and forward trajectory. Her left lateral abdominal and thoracic areas loaded the deployed left front door mounted side air bag which protected her from contact with the interior door panel and armrest. The lateral aspect of the driver's head probably contacted the inflated head bag (ITS) which offered protection from contact against the left front door glazing. There was no contact evidence on the deployed side air bag system. The driver noted that she sustained pain over the scalp area of the left forehead from probable contact with the deployed ITS. She further stated that she sustained a small contusion (AIS-1) over the distal aspect of her left knee. Although no contact evidence was visible within the vehicle, the anterior contusion probably resulted from contact with the knee bolster. The driver refused medical treatment at the scene and did not seek treatment following her departure from the scene of the crash.

Right Front Occupant Demographics

Age/Sex: 16 year old male
Height: 175.3 cm (69.0")
Weight: 63.5 kg (140.0 lb)
Manual Restraint
Usage: 3-point lap and shoulder belt system
Usage Source: Driver interview, vehicle inspection
Type of Medical
Treatment: None, not injured

Right Front Occupant Injuries

Injury	Injury Severity (AIS 90)	Injury Mechanism
Not injured	N/A	N/A

Right Front Occupant Kinematics

The right front occupant of the BMW was a 16 year old male with a height of 175.3 cm (69.0") and weight of 63.5 kg (140.0 lbs). He was wearing a T-shirt and denim jeans. The driver stated that this occupant was seated in a normal upright posture and was properly restrained by the manual 3-point lap and shoulder belt system. The belt system did not yield evidence of loading, however, the latchplate was superficially abraded which indicated previous usage. The right front occupant initiated a lateral trajectory in response to the 10 o'clock impact force. His left hip area contacted the center console/armrest. Although no direct contact evidence was visible on the right side of the center armrest, the assembly was displaced laterally to the left, against the inboard aspect of the left front seat back. The driver stated that this occupant was not injured in the crash. There was no additional evidence of contact within the right front occupant compartment.

Left Rear Occupant Demographics

Age/Sex: 13 year old male
Height: 170.2 cm (67.0")
Weight: 65.8 kg (145.0 lb)
Manual Restraint
Usage: None, 3-point lap and shoulder belt was available
Usage Source: Driver interview, vehicle inspection
Type of Medical
Treatment: None, refused treatment

Left Rear Occupant Injuries

Injury	Injury Severity (AIS 90)	Injury Mechanism
Contusion over the left lateral upper arm	Minor (790402.1,2)	Side impact air bag module cover flap
Contusion of the left lateral chest	Minor (490402.1,2)	Side impact air bag module cover flap

Left Rear Occupant Kinematics

The left rear occupant was a 13 year old male with a driver reported height of 170.2 cm (67.0") and weight of 65.8 kg (145.0 lbs). She stated that he was not wearing the manual 3-point lap and shoulder belt system. The rear seat latchplates did not yield evidence of routine usage previous to this crash. It should be noted that the rear outboard 3-point lap and shoulder belt systems retracted to the inboard aspect of the rear bench seat and buckled to the outboard aspect adjacent to the doors. The left rear seated occupant was wearing a T-shirt and denim jeans at the time of the crash. At impact with the Pontiac, the left rear door mounted side impact air bag deployed from the mid rear aspect of the door panel. The occupant initiated a lateral trajectory into the deployed or deploying side air bag. His pre-crash position was unknown, therefore he could have been leaning against the left rear door panel as the ASAP bag deployed. The occupant sustained a contusion to the left lateral chest (AIS-1), distal to the axilla, and a contusion to the left lateral arm (AIS-1), distal to the shoulder. Both soft tissue injuries probably resulted from his involvement with the deploying left rear door mounted side impact air bag. There was no contact evidence on the air bag and/or cover flap. The dense foam backer panel on the cover flap was fractured at multiple sites with separation of the foam from the upper forward corner and the lower rear corner area of the backer panel. The driver stated that the occupant was displaced laterally to this right by the deployment sequence of the air bag. His lateral trajectory was probably related to rebound. He subsequently exited the vehicle from the right rear door of the BMW and refused medical treatment.

Pontiac Grand Am Driver Injuries/Kinematics

The 17 year old female driver of the Pontiac Grand AM was not wearing the automatic, door mounted 3-point lap and shoulder belt system. She responded to the 01 o'clock impact force by initiating a forward trajectory with respect to the decelerating vehicle. She loaded the steering assembly with her thoracic region which deformed the upper steering wheel rim and compressed the energy absorbing steering column. Her left knee contacted the mid left instrument panel which was evidenced by a tissue transfer and a fracture of the plastic component. Her forehead subsequently contacted and cracked the laminated windshield directly forward of the steering column. Medical data from the insurance carrier indicated that she sustained a left pelvic fracture (AIS-2) and a contusion over the forehead area (AIS-1). She was removed from the vehicle by rescue personnel and transported by ambulance to a local hospital where she was admitted for 19 days for treatment of her fracture.